Lesson 3

Introduction to Case Studies

Goal

To introduce two practical cases of modeling.

Objectives

After completing this lesson, you should be able to:

- Recognize why case studies can be useful.

- Recognize why air quality modeling was necessary in each of the two cases.

- Recognize differences in terrain features and meteorology of the two case-study areas.

Introduction

In Lessons 1 and 2 you learned why air quality modeling is required for New Source Review and Control Strategy Demonstrations. You were introduced to air quality models—what the process of air quality modeling is and what air quality models, in a general sense, are. Air quality models come in all sizes and approaches, and the models become complex as they attempt to fully explain all the physical processes that influence pollution as it is transported and dispersed in the atmosphere. Because there are so many models, not all of them will be discussed in this course. Instead, the course will concentrate on the simple Gaussian point source model, discussing seven such models. The Gaussian point source model, which was among the first models to be developed, has been used for two decades and continues to be useful. The two case studies introduced next are examples of the practical way in which air quality models have been used by industry.

Case Studies

The two case studies will be introduced here and considered in greater detail in Lessons 15 and 16 of this course. Not all the point source models that will be discussed were considered for use in the two examples, which are an oil refinery and an iron-casting plant. Because the two industrial processes are different, the model approaches will be different. The locations are also different; one is in the Southwest and the other is in the Great Lakes area. By studying these cases of modeling, you will gain some insight into models and their uses.

Oil Refinery

The first case to consider is an oil refinery located in northeastern Oklahoma (Figure 3-1). The oil company operating the refinery wants to expand the present facility, which will expand the processing capabilities. The plans require building a new stack 35 meters high and 1.56 meters in diameter. The new stack will be located in the vicinity of the older stack, which is also 35 meters high and 1.56 meters in diameter. The effluent will be SO_2, which is the effluent of the existing stack, so there is concern that the additional effluent will cause the facility to exceed Class II PSD increments for SO_2. The existing effluent rate is 3.28 grams per second (114 tons per year), and because the emissions exceed 100 tons per year of SO_2, the old stack is already a major source. The new stack will have an effluent rate of 1.5 grams per second (52 tons per year), which is a significant increase in emissions, and, therefore, requires that the source be modeled for PSD. (The significance threshold for SO_2 is 40 tons per year or more.) The terrain around the area is uneven and the highest point of land rises 30.8 meters above the base of the stacks. A river runs just west of the refinery. An urban area is located 1.61 kilometers east of the refinery. There are no federal Class I areas within 50 kilometers.
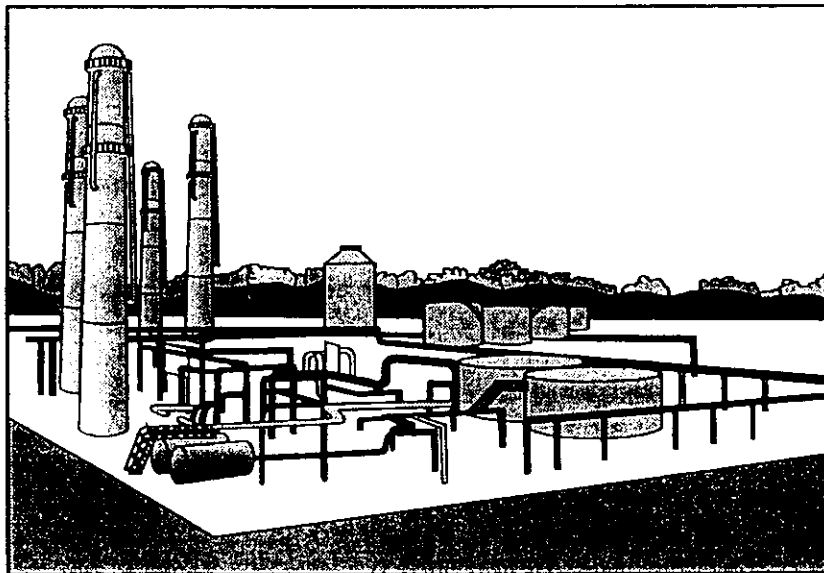

Figure 3-1. Oil Refinery

Iron-Casting Plant

The second case to consider is an iron-casting plant (melting furnace) located in northeastern Michigan (Figure 3-2). A large automobile manufacturer owns the plant, which is used to melt iron ingots in large furnaces before casting automobile engine blocks. No new construction is planned. The company must demonstrate that its effluent does not significantly contribute to the high concentrations of particulate matter (PM_{10}) in the surrounding urban area, which already exceeds the NAAQS for PM_{10}. The 14 stacks at the iron-casting plant emitting particulate matter average 50 meters in height and range from 24 to 70 meters. The stack diameters range from 1.30 to 1.53 meters. The effluent rates of the stacks range from 100 grams per second to 3,966 grams per second. The terrain around the area is essentially flat. A wide river runs just northwest of the plant. There are no federal Class I areas within 50 kilometers.
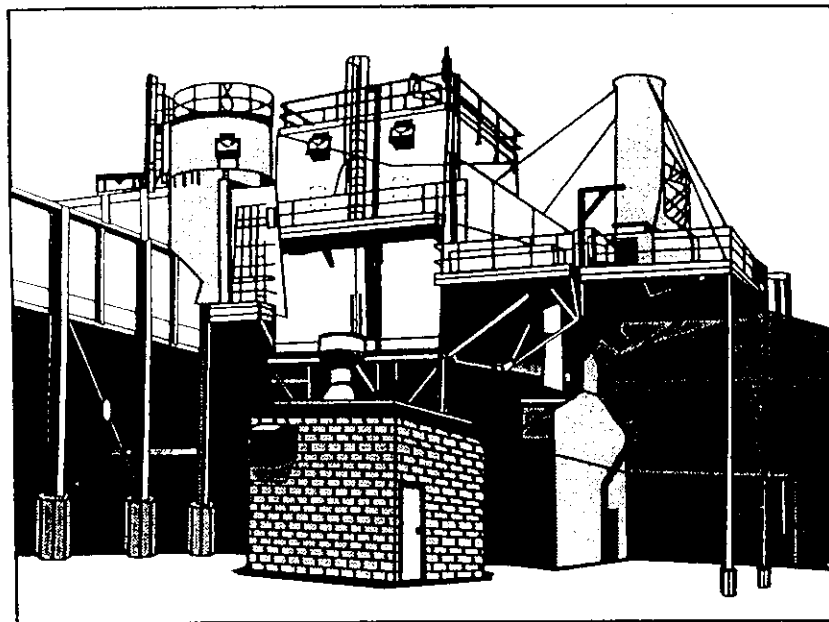

Figure 3-2. Iron-Casting Plant

Summary

The two case studies are introduced at this point in the course to encourage you to think about them as you learn about each of the models. As each model is described, think about whether the model would be useful in either of the two situations just described. These two case studies will be considered in more detail in Lessons 15 and 16. They will be analyzed to illustrate each physical situation and the application of every phase of the modeling process. The models, and why they were chosen, will also be discussed, and, finally, an interpretation of model results (output) will be given. You should compare your choices of models with the model used in each case.

Review Exercises

1. True or false? In the first case study—the oil refinery—the air quality impact of the new stack must be modeled because the proposed expansion will increase SO_2 emissions by a significant amount from a major stationary source.

2. True or false? One reason case studies of modeling are included in this course is because they help you gain insight into models and their practical use.

3. True or false? In the second case study—the iron-casting plant—the facility must be modeled for New Source Review.

4. The two case studies were located in the:

    a. Northwest and Great Salt Lake area

    b. Southeast and Great Lakes area

    c. Southwest and Great Lakes area

    d. Northeast and Great Salt Lake area

5. True or false? Both areas had to be modeled because of PSD requirements.

Review Answers

1. True

2. True

3. False

4. c. Southwest and Great Lakes area

5. False